Observations for ascertaining the Length of the Pendulum at Madras in the East Indies, Latitude 13° 4′ 9″·1 *N.; with the Conclusions drawn from the same. By* John Goldingham, *Esq. F.R.S.* Read January 31, 1822. [*Phil. Trans.* 1822, *p.* 127.]

The observations detailed in this paper are comprised in two series. By the result of the first, the pendulum of experiment, which was constructed upon the same principles as that used by Captain Kater, and described in the Philosophical Transactions for 1819, was found to make 86166,108 vibrations in twenty-four hours, and by the result of the second series, 86166,048, the mean being 86166,078; so that the result of each series differs from the mean only $\frac{3}{1000}$th of a beat in twenty-four hours.

The length of the seconds pendulum at Madras, deduced as the mean of these two series of observations, is 39·026302 inches of Sir George Shuckburgh's scale, at the temperature of 70° in vacuo, and at the level of the sea.

By comparing this with the length of the pendulum vibrating seconds in London, we obtain $\frac{1}{297.56}$ as the ellipticity of the earth, which is very nearly the mean deduced from the observations of Captain Kater in England, and those of the French mathematicians.

Account of an Assemblage of Fossil Teeth and Bones of Elephant, Rhinoceros, Hippopotamus, Bear, Tiger, and Hyæna, and sixteen other Animals; discovered in a Cave at Kirkdale, Yorkshire, in the year 1821: *with a comparative View of five similar Caverns in various Parts of England, and others on the Continent. By the Rev.* William Buckland, *F.R.S. F.L.S. Vice President of the Geological Society of London, and Professor of Mineralogy and Geology in the University of Oxford, &c. &c. &c.* Read February 21, 1822. [*Phil. Trans.* 1822, *p.* 171.]

The rock in which the cavern, mentioned in the title of this paper, is formed, is that species of limestone called Oolite. Its greatest length is from 250 to 300 feet, and its breadth and height vary from two to seven feet, there being few places in which it is possible to stand upright. Its bottom was covered by a sediment of mud, and the roof and sides, as well as the surface of the mud, were incrusted by stalactitic matter. The animal remains were found, not upon the surface, but in the lower part only of this muddy deposit, and in the stalagmitic accumulations beneath it, and were thus remarkably preserved from decay. The teeth and bones hitherto discovered are those of the hyæna, fox, bear, of an animal of the tiger kind, of the elephant, rhinoceros, hippopotamus, and horse, of the ox and some species of deer, of the water rat and the rabbit. They were strewed promiscuously over the bottom of the cave; the bones, with very few exceptions, being broken and apparently gnawed; for upon many of them marks were detected fitting the form of the canine teeth of the hyænas that were found there: whence it appears probable that this

was once a den of hyænas, who dragged into its recesses the other animal bodies, whose remains are mixed indiscriminately with their own; a conjecture, says the author, rendered almost certain, by the discovery of a portion of solid calcareous excrement, recognized by the keeper of the Menagerie at Exeter 'Change, from its resemblance to that of the Cape hyæna; the analysis, too, of this excrement shows its derivation from bones, as it consists chiefly of phosphate and carbonate of lime.

It appears from the researches of M. Cuvier, that the fossil hyæna was nearly one third larger than the largest of the modern species, of the habits of which the author gives an account, with a view of verifying and illustrating his opinion concerning the state and origin of the contents of the Yorkshire cave. Even the abundance of the remains of water rats, he says, is consistent with the omnivorous appetite of modern hyænas. In respect to ruminating animals, as they form the ordinary food of beasts of prey, the quantity of their bones is not surprising; but the abundant occurrence of some of the other remains, in a cave of the dimensions of that described, is not so obvious; since such animals as the elephant, rhinoceros, and hippopotamus, could not possibly have found an entrance, and since it is foreign to the habits of the hyæna to prey on the larger pachydermata. As a solution of this difficulty, the author supposes that the remains in question are those of individuals who died a natural death; and though the hyæna would neither have had strength to kill an elephant or rhinoceros, nor to drag home the entire carcase of a dead one, yet he might convey the most bulky animals piecemeal into his den, supposing them to have died in the neighbourhood. From this view of the subject it appears probable that the accumulation of these bones went on during a succession of years, while the animals in question were natives of this country; and the general dispersion of similar bones through the diluvian gravel of high latitudes, over a great part of the northern hemisphere, shows that the period at which they inhabited these regions was that immediately preceding the formation of this gravel, and that they perished by the waters that produced it. Moreover, as all these animals belong to species now unknown, and as there is no evidence of their ever having existed subsequent to the formation of the diluvium, we may conclude that the period at which the bones were introduced into the Kirkdale cave was antediluvian. That these extinct species never re-established themselves after the deluge, seems proved by the total absence of their remains in the varieties of postdiluvian accumulations of sand, mud, and peat, in which, however, we find the remains of horses, deer, and some other animals.

The phenomena, then, of this cave seem referable to a period at which the world was inhabited by land animals bearing only a general resemblance to those now existing, before the last inundation of the earth. So completely, however, had the violence of that tremendous convulsion destroyed and remodelled the form of its antediluvian surface, that it is only in caverns protected from its ravages that we may

hope to find undisturbed evidence of the events occurring in the immediately antecedent period; and such seem to be the bones and stalagmite formed before the introduction of the diluvian mud in the Kirkdale cave.

The author then proceeds to take a general view of the operations successively going on in this cave, founded upon his previous minute descriptions of its contents; of its earliest period when it was an unoccupied aperture; of its second period, when tenanted by hyænas, during which, as well as the former, stalagmite and stalactite were forming, though necessarily interrupted by the ingress and egress of its lodgers; of the third period, when the animals were extirpated and the mud introduced, and which appears therefore to have been that of the deluge; and of the fourth and last period, during which the superficial stalagmite incrusting the mud was formed, and in which no creature appears to have entered the cave till it was opened last summer, and no other process to have been going on than the uninterrupted formation of stalactite.

The strata of diluvial sediment seem to mark the point of time at which the latter state of things began, and the former ceased; and the limited quantity of postdiluvian stalactite, no less than the undecayed condition of the bones, tends to show that the time elapsed since the introduction of the mud has not been of excessive length.

Professor Buckland concludes this paper with an application of the arguments arising out of the detail of facts which it contains, to the illustration of other similar phenomena, where the evidence of their origin is less complete; of these, five are in our own country, and the author avails himself of their history, together with that of the Kirkdale cave, to elucidate the account of analogous caverns, which have been more or less perfectly examined in various parts of the Continent of Europe.

Communication of a curious Appearance lately observed upon the Moon. By the Rev. Fearon Fallows. *In a Letter addressed to* John Barrow, *Esq. F.R.S.* Read February 28, 1822. [*Phil. Trans.* 1822, *p.* 237.]

On the evening of the preceding 28th November, Mr. Fallows observed a luminous spot on the dark part of the moon's limb, which, by aid of a four-feet achromatic telescope, of a power of 100, seemed like a star of the sixth magnitude; three others much smaller were also remarked, but want of proper instruments prevented Mr. Fallows from ascertaining their situation. On the 29th, the large spot was as brilliant as on the preceding evening, the other two nearly invisible, and the third and most brilliant of the small spots had disappeared. On the 30th, the weather prevented further observations.